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SCIENCE

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ENGINEERING SCIENCE BEFORE, DURING AND AFTER THE WAR. II

IN coming to this section of my address I am reminded that in the course of his presidential address to section G, in 1858, Lord Rosse said:

> Another object of the Mechanical Section of the association has been effected—the importance of engineering science in the service of the state has been brought more prominently forward. There seems, however, something still wanting. Science may yet do more for the Navy and Army if more called upon.

Comparatively recently too, Lord French remarked:

> We have failed during the past to read accurately the lessons as regards the fighting of the future which modern science and invention should have taught us.

In view of the eminent services which men of science have rendered during the war, I think that we may be justified in regarding the requirement stated by Lord Rosse as having at last been satisfied, and also in believing that such a criticism as Lord French rightly uttered will not be levelled against the country in the future.

Though British men of science had not formerly been adequately recognized in relation to war and the safety of their country, yet at the call of the sailors and the soldiers they whole-heartedly, and with intense zeal, devoted themselves to repair the negligence of the past, and to apply their unrivalled powers and skill to encounter and overcome the long-standing machinations of the enemy. They worked in close collaboration with the men of science of the allied nations, and eventually produced better war material, chem-

icals, and apparatus of all kinds for vanquishing the enemy and the saving of our own men than had been devised by the enemy during many years of preparation planned on the basis of a total disregard of treaties and the conventions of war.

Four years is too short a time for much scientific invention to blossom to useful maturity, even under the forced exigencies of war and government control. It must be remembered that in the past the great majority of new discoveries and inventions of merit have taken many years—sometimes generations—to bring them into general use. It must also be mentioned that in some instances discoveries and inventions are attributable to the general advance in science and the arts which has brought within the region of practical politics an attack on some particular problem. So the work of the men of science during the war has perforce been directed more to the application of known principles, trade knowledge and properties of matter to the waging of war than to the making of new and laborious discoveries; though, in effecting such applications, inventions of a high order have been achieved some of which promise to be of great usefulness in time of peace.

The advance of science and the arts in the last century had, however, wrought a great change in the implements of war. The steam-engine, the internal-combustion engine, electricity, and the advances in metallurgy and chemistry had led to the building up of immense industries which, when diverted from their normal uses, have produced unprecedented quantities of war material for the purposes of the enormous armies, and also for the greatest navy which the world has ever seen.

The destructive energy in the field and afloat has multiplied many hundredfold since the time of the Napoleonic wars; both before and during the war the size of guns and the efficiency of explosives and shell increased immensely, and many new implements of destruction were added. Modern science and engineering enabled armies unprecedented in size, efficiency and equipment to be drawn from all parts of the world and to be concentrated rapidly in the fighting line.

To build up the stupendous fighting organization, ships have been taken from their normal trade routes, locomotives and material from the home railways, the normal manufactures of the country have been largely diverted to munitions of war; the home railways, tramways, roads, buildings and constructions, and material of all kinds have been allowed to depreciate. The amount of depreciation in roads and railways alone has been estimated at £400,000,000 per annum at present prices. Upon the community at home a very great and abnormal strain has been thrown, notwithstanding the increased output per head of the workers derived from modern methods and improved machinery. In short, we have seen for the first time in history nearly the whole populations of the principal contending nations enlisted in intense personal and collective effort in the contest, resulting in unprecedented loss of life and destruction of capital.

A few figures will assist us to realize the great difference between this war and all preceding wars. At Waterloo, in 1815, 9,044 artillery rounds were fired, having a total weight of 37.3 tons, while on one day during the last offensive in France, on the British front alone, 943,837 artillery rounds were fired, weighing 18,080 tons—more than 100 times the number of rounds, and nearly 540 times the weight of projectiles. Again, in the whole of the South African War 273,000 artillery rounds were fired, weighing approximately

2,800 tons; while during the whole war in France, on the British front alone, more than 170,000,000 artillery rounds were fired, weighing nearly 3,500,000 tons—622 times the number of rounds, and about 1,250 times the weight of projectiles.

However great these figures in connection with modern land artillery may be, they become almost insignificant when compared with those in respect of a modern naval battle squadron. The *Queen Elizabeth* when firing all her guns discharges 18 tons of metal and develops 1,870,000 foot-tons of energy. She is capable of repeating this discharge once every minute, and when doing so develops by her guns an average of 127,000 effective h.p., or more than one and one half times the power of her propelling machinery; and this energy is five times greater than the maximum average energy developed on the western front by British guns. Furthermore, if all her guns were fired simultaneously, they would for the instant be developing energy at the rate of 13,132,000 h.p. From these figures we can form some conception of the vast destructive energy developed in a modern naval battle.

With regard to the many important engineering developments made during the war, several papers by authorities are announced in the syllabus of papers constituting the sectional proceedings of this year's meeting. Among them are "Tanks," by Sir Eustace d'Eyncourt; "Scientific Progress of Aviation during the War," by L. Bairstow; "Airships," by Lieutenant-Colonel Cave-Brown-Cave; "Directional Wireless, with Special Reference to Aircraft," by Captain Robinson; "Wireless in Aircraft," by Major Erskine Murray; "Wireless Telegraphy during the First Three Years of the War," by Major Vincent Smith; "Submarine Mining," by Commander Gwynne; "Emergency Bridge Construction," by Professor Ingles; and "The Paravane," by Commander Burney. Accordingly, it is quite unnecessary here to particularize further except in the few following instances:

Sound-ranging and Listening Devices.—Probably the most interesting development during the war has been the extensive application of sound-listening devices for detecting and localizing the enemy. The Indian hunter puts his ear to the ground to listen for the sound of the footsteps of his enemy. So in modern warfare science has placed in the hands of the sailor and soldier elaborate instruments to aid the ear in the detection of noises transmitted through earth, water, air or ether, and also in some cases to record these sounds graphically or photographically, so that their character and the time of their occurrence may be tabulated.

The sound-ranging apparatus developed by Professor Bragg and his son, by which the position of an enemy gun can be determined from electrically recorded times at which the sound-wave from the gun passes over a number of receiving stations, has enabled our artillery to concentrate their fire on the enemy's guns, and often to destroy them.

The French began experimenting in September, 1914, with methods of locating enemy guns by sound. The English section began work in October, 1915, adopting the French methods in the first instance. By the end of 1916 the whole front was covered, and sound-ranging began to play an important part in the location of enemy batteries. During 1917 locations by sound-ranging reached about 30,000 for the whole army, this number being greater than that given by any other means of location. A single good set of observations could be relied upon to give the position of an enemy gun to about 50 yards at 7,000

yards' range. It could also be carried on during considerable artillery activity.

The apparatus for localizing noises transmitted through the ground has been much used for the detection of enemy mining and counter-mining operations. Acoustic tubes, microphones and amplifying valves have been employed to increase the volume of very faint noises.

For many years before the war the Bell Submarine Signalling Co., of which Sir William White was one of the early directors, used submerged microphones for detecting sound transmitted through the water, and a submerged bell for sending signals to distances up to one mile. With this apparatus passing ships could be heard at a distance of nearly a mile when the sea was calm and the listening vessel stationary.

Of all the physical disturbances emitted or produced by a moving submarine, those most easily detected, and at the greatest distance, are the pressure-waves set up in the water by vibrations produced by the vessel and her machinery. A great variety of instruments have been devised during the war for detecting these noises, depending on microphones and magnetophones of exceedingly high sensitivity. Among them may be particularly mentioned the hydrophones devised by Captain Ryan and Professor Bragg, being adaptations of the telephone transmitter to work in water instead of air. These instruments, when mounted so as to rotate, are directional, being insensitive to sound-waves the front of which is perpendicular to the plane of the diaphragm, and giving the loudest sound when the diaphragm is parallel to the wave-front.

Another preferable method for determining direction is to use two hydrophones coupled to two receivers, one held to each ear. This is called the biaural method, and enables the listener to recognize the direction from which the sound emanates.

When the vessel is in motion or the sea is rough, the water noises from the dragging of the instrument through the water and from the waves striking the ship drown the noises from the enemy vessel, and under such conditions the instruments are useless. The assistance of eminent biologists was of invaluable help at this juncture. Experiments were made with sea-lions by Sir Richard Paget, who found that they have directional hearing under water up to speeds of six knots. Also Professor Keith explained the construction of the hearing organs of the whale, the ear proper being a capillary tube, too small to be capable of performing any useful function in transmitting sound to the relatively large aural organs, which are deep set in the head. The whale therefore hears by means of the sound-waves transmitted through the substance of the head. It was further seen that the organs of hearing of the whale to some degree resembled the hydrophone.

The course now became clear. Hollow towing bodies in the form of fish or porpoises were made of celluloid, varnished canvas, or very thin metal, and the hydrophone suitably fixed in the center of the head. The body is filled with water, and the cable towing the fish contains the insulated leads to the observer on board the vessel. When towed at some distance behind the chasing ship disturbing noises are small, and enemy noises can be heard up to speeds of fourteen knots, and at considerable distances. Thermionic amplifying valves have been extensively used, and have added much to the sensitiveness of the hydrophone in its many forms.

After the loss of the *Titanic* by collision with an iceberg, Lewis Richardson was granted two patents in 1912 for the de-

tection of above-water objects by their echo in the air, and under-water objects by the echo transmitted through the water. The principles governing the production and the concentration of beams of sound are described in the specification, and he recommends frequencies ranging from 4,786 to 100,000 complete vibrations per second, and also suggests that the rate of approach or recession from the object may be determined from the difference in the pitch of the echo from the pitch of the blast sent out. Sir Hiram Maxim also suggested similar apparatus a little later.

The echo method of detection was not, however, practically developed until French and English men of science, with whom was associated Professor Langevin, of the Collège de France, realizing its importance for submarine detection, brought the apparatus to a high degree of perfection and utility shortly before the armistice. Now with beams of high-frequency sound-waves it is possible to sweep the seas for the detection of any submerged object, such as icebergs, submarines, surface vessels, and rocks; they may also be used to make soundings. It enables a chasing ship to pick up and close in on a submarine situated more than a mile away.

The successful development of sound-ranging apparatus on land led to the suggestion by Professor Bragg that a modified form could be used to locate under-water explosions. It has been found that the shock of an explosion can be detected hundreds of miles from its source by means of a submerged hydrophone, and that the time of the arrival of the sound-wave can be recorded with great precision. At the end of the war the sound-ranging stations were being used for the detection of positions at sea required for strategical purposes. The same stations are now being used extensively for the determination of such positions at sea as light-vessels, buoys which indicate channels, and obstructions such as sunken ships. By this means ships steaming in fog can be given their positions with accuracy for ranges up to 500 miles.

Among the many other important technical systems and devices brought out during the war which will find useful application under peace conditions as aids to navigation I may mention directional wireless, by which ships and aircraft can be given their positions and directed, and on this subject we are to have a paper in Section G.

Leader-gear, first used by the Germans to direct their ships through their mine fields, and afterwards used by the Allies, consists of an insulated cable laid on the bottom of the sea, earthed at the farther end, through which an alternating current is passed. By means of delicate devices installed on a ship, she is able to follow the cable at any speed with as much precision as a railless electric 'bus can follow its trolley-wire. Cables up to fifty miles long have been used, and this device promises to be invaluable to ships navigating narrow and tortuous channels and entering or leaving harbors in a fog.

Aircraft.—It may be justly said that the development in aircraft design and manufacture is one of the astonishing engineering feats of the war. In August, 1914, the British Air Services possessed a total of 272 machines, whereas in October, 1918, just prior to the armistice, the Royal Air Force possessed more than 22,000 effective machines. During the first twelve months of the war the average monthly delivery of aeroplanes to our Flying Service was 50, while during the last twelve months of the war the average deliveries were 2,700 per month. So far as aero-engines are

concerned, our position in 1914 was by no means satisfactory. We depended for a large proportion of our supplies on other countries. In the Aerial Derby of 1913, of the eleven machines that started, not one had a British engine. By the end of the war, however, British aero-engines had gained the foremost place in design and manufacture, and were well up to requirements as regards supply. The total horse-power produced in the last twelve months of the war approximated to eight millions of brake horse-power, a figure quite comparable with the total horse-power of the marine-engine output of the country.[1]

Much might be written on the progress in aircraft, but the subject will be treated at length in the sectional papers. In view of the recent trans-Atlantic flight, however, I feel that it may be opportune to make the following observations on the comparative utility of aeroplanes and airships for commercial purposes. In the case of the aeroplane, the weight per horse-power increases with the size, other things being equal. This increase, however, is met to some extent by a multiplicity of engines, though in the fuselage the increase remains.

On the other hand, with the airship the advantage increases with the size, as in all ships. The tractive effort per ton of displacement diminishes in inverse proportion to the dimensions, other things, including the speed, being the same. Thus an airship of 750 feet length and 60 tons displacement may require a tractive force of 5 per cent., or 3 tons, at 60 miles per hour; and one of 1,500 feet in length and $8 \times 60 = 480$ tons displacement would require only $2\frac{1}{2}$ per cent. $\times 480 = 12$ tons at the same speed, and would carry fuel for double the distance.

[2] See Lord Weir's paper read at the Victory meeting of the Northeast Coast Institution of Engineers and Shipbuilders, July, 1919.

With the same proportion of weight of hull to displacement, the larger airship would stand double the wind-pressure, and would weather storms of greater violence and hailstones of greater size. It would be more durable, the proportional upkeep would be less, and the proportional loss of gas considerably less. In other words, it would lose a less proportion of its buoyancy per day. It is a development in which success depends upon the project being well thought out and the job being thoroughly well done. The equipment of the airsheds with numerous electric haulage winches, and all other appliances to make egress and ingress to the sheds safe from danger and accident, must be ample and efficient.

The airship appears to have a great future for special commerce where time is a dominant factor and the demand is sufficient to justify a large airship. It has also a great field in the opening up of new countries where other means of communication are difficult. The only limitation to size will be the cost of the airship and its sheds, just as in steam vessels it is the cost of the vessels and the cost of deepening the harbors that limit the size of Atlantic liners.

Such developments generally take place slowly, otherwise failures occur—as in the case of the *Great Eastern*—and it may be many years before the airship is increased from the present maximum of 750 feet to 1,500 feet with success, but it will assuredly come. If, however, the development is subsidized or assisted by the government, incidental failures may be faced with equanimity and very rapid development accomplished.[3] In peace-time the seaplane, aeroplane and airship will most certainly have their uses. But, except for special services of high utility, it is ques-

[3] The literature on this subject includes an article which appeared in *Engineering* on January 3, 1919.

tionable whether they will play more than a minor part as compared with the steamship, railway and motor transport.

Electricity.—The supply and use of electricity has developed rapidly in recent years. For lighting it is the rival of gas, though each has its advantages. As a means of transmitting power over long distances it has no rival, and its efficiency is so high that, when generated on a large scale and distributed over large areas, it is a cheap and trustworthy source of power for working factories, tramways, suburban railways and innumerable other purposes, including metallurgical and chemical processes. It is rapidly superseding locally generated steam-power, and is a rival to the small- and moderate-sized gas and oil engines. It has made practicable the use of water-power through the generation of electricity in bulk at the natural falls, from which the power is transmitted to the consumers, sometimes at great distances.

Fifteen years ago electricity was generated chiefly by large reciprocating steam-engines, direct-coupled to dynamos or alternators, but of late years steam turbines have in most instances replaced them, and are now exclusively used in large generating stations because of their smaller cost and greater economy in fuel. The size of the turbines may vary from a few thousand horse-power up to about 50,000 h.p. At the end of last year the central electric stations in the United Kingdom contained plant aggregating 2,750,000 kilowatts, 79 per cent. of which was driven by steam turbines.

Much discussion has taken place as to the most economical size of generating stations, their number, the size of the generating units, and the size of the area to be supplied. On the one hand, a comparatively small number of very large or super-stations, instead of a large number of moderate-sized stations dotted over the area, results in a small decrease in the cost of production of the electricity, because in the super-stations larger and slightly more economical engines are employed, while the larger stations permit of higher organization and more elaborate labor-saving appliances. Further, if in the future the recovery of the by-products of coal should become a practical realization as part of the process in the manufacture of the electric current, the larger super-stations present greater facilities than the smaller stations. On the other, super-stations involve the transmission of the electricity over greater distances, and consequently greater capital expenditure and cost of maintenance of mains and transmission apparatus, and greater electrical transmission losses, while the larger generating unit takes longer to overhaul or repair, and consequently a larger percentage of spare plant is necessary.

The greatest element in reducing the cost of electricity is the provision of a good load factor; in other words, the utilization of the generating plant and mains to the greatest extent during the twenty-four hours of each day throughout the year. This is a far more important consideration than the size of the station, and it is secured to the best advantage in most cases by a widespread network of mains, supplying a diversity of consumers and users, each requiring current at different times of the day. The total load of each station being thus an average of the individual loads of a number of consumers is, in general, far less fluctuating than in the case of small generating and distributing systems, which supply principally one class of consumer—a state of affairs that exists in London, for instance, at the present time. It is true that there may be exceptional cases, such as at Kilmar-

nock, where a good load factor may be found in a small area, but in this case the consumers are chiefly mills, which require current for many hours daily.

There is no golden rule to secure cheap electricity. The most favorable size, locality and number of generating stations in each area can only be arrived at by a close study of the local conditions, but there is no doubt that, generally speaking, to secure cheap electricity a widespread network of mains is in most cases a very important, if not an essential, factor.

The electrification of tramways and suburban railways has been an undoubted success where the volume of traffic has justified a frequent service, and it has been remarkable that where suburban lines have been worked by frequent and fast electrical trains there has resulted a great growth of passenger traffic. The electrification of main-line railways would no doubt result in a saving of coal; at the same time, the economical success would largely depend on the broader question as to whether the volume of the traffic would suffice to pay the working expenses and provide a satisfactory return on the capital.

Municipal and company generating stations have been nearly doubled in capacity during the war to meet the demand from munition works, steel works, chemical works, and for many other purposes. The provision of this increased supply was an enormous help in the production of adequate munitions. At the commencement of the war there were few steel electric furnaces in the country; at the end of last year 117 were at work, producing 20,000 tons of steel per month, consisting chiefly of high-grade ferro alloys used in munitions.

Charles A. Parsons

(To be concluded)

PHYSIOLOGICAL ISOLATION BY LOW TEMPERATURE IN BRYOPHYLLUM AND OTHER PLANTS

In axiate plants a physiologically active growing tip inhibits more or less completely the development of other growing tips or axes of the same plant within a certain distance which varies to some extent with the intensity of physiological or metabolic activity in the inhibiting tip. This physiological correlation is not specific for the growing tips of stems and roots, but other parts of the plant, *e. g.*, leaves, may exert the same inhibiting effect to a greater or less degree. Removal of the growing tip or other inhibiting part, or a sufficient decrease in its metabolic activity abolishes its inhibiting action upon other parts. These facts have long been known, much experimental work has been done upon this problem of physiological correlation and various hypotheses have been advanced. As regards the manner in which such an effect of one part upon another at a greater or less distance may conceivably be produced, there are apparently three possibilities: first, the growing tip may inhibit indirectly by obtaining through its greater physiological activity the greater proportion of nutritive materials necessary for growth and development; second, the growing tip or other inhibiting part may produce substances which are transported by the fluids of the plant and which exert a specific inhibiting effect upon other parts; and third, the metabolic activity of the growing tip may produce dynamic changes which are conducted through the protoplasm of the plant and influence the physiological condition of the parts which they reach.

As regards the first of these possibilities it is difficult to conceive how in the bean seedling, to take a concrete case, the growing tip can so completely deprive the buds in the axils of the cotyledons of nutrition that they are unable to grow at all, although they are very much nearer the source of both inorganic and organic nutrition than the tip. The attempt to interpret this inhibition solely in nutritive terms has proven unsatisfactory.

The second possibility, the production of

more or less specific inhibiting substances, which are transported to other parts of the plant, also presents certain difficulties and inconsistencies. In the first place every growing tip must be immune to the inhibiting substances which it produces, yet these substances inhibit other growing tips; second, in the normal growth of most plants new growing tips of stems usually arise from previously existing growing tips: it is not their origin but their later development which is inhibited; third, the correlation exists in many simple plants, such for example as algæ, where there is, so far as we know, no mechanism for the transportation of such substances through the plant body; fourth, the inhibiting action is not a specific function of growing tips of stems for a leaf may inhibit a bud. In short when we attempt to interpret the facts in terms of inhibiting substances inconsistencies and contradictions began at once to appear.

The third possibility, that of a dynamic change of some sort, transmitted through the protoplasm, has been suggested by various authors, but the problem of the mechanism by which such a transmitted change produces an inhibiting effect has not been adequately considered.

Most experimental work along this line has consisted either in removing, or stopping or retarding the physiological activity of the inhibiting tip or other part, or in physical isolation of the inhibited part from its action. Another method of attack upon the problem which has been but little used consists in attempting to block the correlative factor somewhere along its path in the intact plant.[1] If it is possible to accomplish this blocking without injury to the plant and to make it temporary, *i. e.*, reversible, the nature of the conditions which bring about the block and the behavior of the parts of the plant on the two sides of the block may be expected to afford at least some basis for conclusions concerning the nature of the correlative factor which is blocked.

The experiments briefly described below were undertaken because it was believed that this method of temporarily blocking the correlative factor in its passage would prove particularly fruitful in plants and would afford a means of testing still further the general conception of physiological axiation which has been formulated by one of us on the basis of many different lines of zoological and botanical evidence.

These experiments are concerned with the effect of low temperature as a block to the action of the growing tip upon other parts of the plant. The method of experimentation consists in subjecting to a low temperature some portion of the plant between the inhibiting growing tip and the part which it inhibits, while the inhibiting growing tip and the inhibiting part which it is desired to isolate remain at the usual temperature. More specifically a portion, two centimeters or more in length of the stem, petiole, runner, etc., is surrounded by a coil of tubing through which flows a current of water, at a low, controlled temperature. In order to avoid injury, the diameter of the coil is made large enough so that it does not touch the plant, the portion to be inclosed is wrapped in tinfoil, the space between it and the coil is lightly packed with damp absorbent cotton, and finally the coil, together with the portion of the plant surrounded by it, is wrapped lightly with a bandage of dry raw cotton. In this way a localized region can be maintained at any desired temperature above zero with very slight variation, provided the temperature of the water flowing through the coil is kept constant. In the apparatus used in these experiments the temperature variation inside the coil can be controlled within one degree Centigrade. The plants are kept in a greenhouse at a temperature ranging from 20° to 25° C., while the region surrounded by the coil is kept at a much lower temperature, in most experiments at approximately 3° C., though in some cases temperatures as high as 5° or even 6° have been found effective.

The results of these experiments with low temperature are briefly as follows: It is a familiar fact that in *Bryophyllum* new plants develop from the notches of the leaves when

[1] McCallum, *Bot. Gaz.*, XL., 1905, attempted to block the correlative action by means of localized anesthesia and obtained results of great interest.

the leaves are separated from the parent plant and placed in water or in a saturated atmosphere. We have found that when a length of 2 to 3 centimeters of the petiole is kept at a temperature 2.5° to 3° and the leaf immersed in water at room temperature, the notches, or some of them, will develop into new plants, while the leaf is still attached to the parent plant. The low temperature does not visibly injure the petiole and after its removal the development of the notches may again be inhibited or retarded. Moreover, it can be shown in this way that each leaf exerts a correlative action upon the leaf opposite and to some extent upon other leaves near it, this action extending farther down the stem than upward. For example when the petiole of one leaf is kept at low temperature, development occurs not only in the notches of this leaf but in at least some of those of the opposite leaf and sometimes in some of the notches of the next pair above and of one or two pairs below, if these leaves are immersed in water. In general the effect upon other leaves of the physiological isolation of one leaf apparently decreases with increasing distance from the isolated leaf and more rapidly upward than downward.

Very commonly the development of the notches is less rapid in the leaf with the low temperature zone on its petiole than in the opposite leaf, although the two leaves themselves are at the same temperature. This difference in rate of development is probably due to the fact that the low temperature zone brings about some disturbance in the movement of nutrition to the leaf and so delays somewhat the development of its buds.

Young plants of the scarlet runner bean *Phaseolus multiflorus,* and Lima bean, *Phaseolus macrocarpus* have also been much used in these experiments with even more satisfactory results than *Bryophyllum.* In these species buds are present in the axils of the cotyledons, but in normal plants these buds never develop beyond minute outgrowths. When a length of 2 or 3 centimeters of the stem above the cotyledons and below the first pair of leaves is inclosed in a coil at 3°, 4° and usually even 5° C., these buds develop, although the plant above the zone of low temperature shows no wilting and at most only a slight retardation of growth for two or three days. Moreover, the development of all axillary buds above the zone of low temperature is inhibited as in normal plants, but the inhibiting factor is blocked by the low temperature zone, although water and nutritive substances obviously pass it. When the low temperature coil is removed from the stem the growth of the buds in the axils of the cotyledons may be again inhibited, and may be again started by replacing the low temperature. If, however, the physiological isolation by low temperature is maintained long enough to permit these buds to develop into shoots several centimeters long, they often continue to grow more or less rapidly after the low temperature is removed and in some cases may even inhibit the further growth of the chief tip. In these bean seedlings the effect of the low temperature zone is visible in the growth of the buds within one to two days.

In the same way other axillary buds at higher levels of the stem may be physiologically isolated and induced to develop, while the chief growing tip continues to grow and to inhibit all buds above the zone of low temperature. In most plants a temperature of 5° or 6° C., constitutes an effective block to the inhibiting action of the chief growing tip for several days, but these temperatures are near the upper limit of effectiveness for this species, and adjustment or acclimation of the cooled zone gradually occurs to such a degree that the buds which were at first physiologically isolated are again inhibited and cease to grow even before the low temperature is removed. When lower temperatures are used such acclimation may occur to some extent, but is less rapid.

Physiological isolation of the runner-tip of *Saxifraga sarmentosa* may also be brought about by low temperature. The runners of this plant, like those of the strawberry and various other forms, grow to a certain length, and then the bud at the tip of the runner develops into a new plant, and growth in length of the runner ceases. The more active the parent plant, the longer the runner grows

before its tip develops. When the plants are in good condition the runners attain a length of 20 to 30 centimeters or even more before development of the tip occurs. When the length of 2 to 3 centimeters of a growing runner is kept at a temperature of 3° to 4° C., development of the new plant usually begins within two to four days, and very little further growth in length of the runner occurs, even though its length is much less than the normal length of runner produced by the same plant. Since each plant produces numerous runners in succession, and since the normal length of runner at any given time is very definite, several runners, of both earlier and later origin than the experimental runner and from the same plant, may be used as controls. There is no wilting of the runner distal to the low temperature zone, and the tip evidently receives nutrition, for the growth and development of the new plant take place as rapidly as in normal runners which have attained their full length. It should be noted, moreover, that these runner-tips are not permitted to touch the ground and become rooted, but are kept suspended in air.

Work with this method is being continued and further results will be reported and apparatus and technique more fully described in later papers. The results already obtained, together with certain conclusions to which they point are summarized as follows: first, the inhibiting action of the growing tip of the plant upon other buds, or of a leaf upon buds on other leaves, as in *Bryophyllum*, can be blocked by a zone of low temperature which does not prevent the flow of water and nutritive substances; second, the block produced by the zone of low temperature does not involve any visible or permanent alteration of the tissues, but is wholly reversible; third, a temperature which is at first an effective block may become ineffective after a few days, because of acclimation of the cooled zone to that temperature; fourth, in view of the above facts it appears at least highly probable that the inhibiting action of growing tip, a leaf, or other active region of a plant, depends for its passage from point to point upon metabolically active protoplasm, rather than upon purely physical transportation in the fluids flowing through "preformed channels" in the plant. In other words, the mechanism of this physiological correlation appears to possess at least certain of the characteristics of a transmissive or conductive, as distinguished from a purely transportative mechanism.

C. M. CHILD,
A. W. BELLAMY

SCIENTIFIC EVENTS

THE BRITISH NATIONAL PHYSICAL LABORATORY

SIR RICHARD GLAZEBROOK, as already recorded in SCIENCE, resigned the directorship of the National Physical Laboratory, Teddington, which he has held since its inception in 1899 on September 18, his sixty-fifth birthday.

Sir Richard was principal of Liverpool University when he received the appointment to the laboratory, which was founded by the Royal Society, and was originally intended as an extension of Kew Observatory. When the new buildings were opened at Teddington in 1902 it had but two departments and a staff of twenty-six. At the present time the staff numbers about 600, and building operations are still in progress for the accommodation of new departments in research work.

As already announced Richard Glazebrook is succeeded by Professor Petavel, professor of engineering and director of the Whitworth Laboratory in the University of Manchester.

The London *Times* writes:

Sir Richard Glazebrook, who retires from the directorship of the National Physical Laboratory, has controlled its fortunes from its small beginnings in 1899 to its present great place in the scientific organization of the nation. It was first intended merely to carry out investigations required in connection with the manufacture and testing of instruments of precision, and in 1902, when it was moved to new buildings at Teddington, it had only two departments and a staff of twenty-six. It has now seven scientific departments, a secretariat, and a staff of over 600 persons. These deal with heat, optics, acoustics and molecular physics, with electricity, metrology, engineering, metallurgy, the forms of ships and aerial machines, and aero-dynamics. It is the supreme

scientific court of appeal and advice for all questions involving the physical properties of matter, the strength and quality of materials, gauges and standards. During the war it rendered invaluable service. In the financial year ending in March, 1918, the Ministry of Munitions alone paid it £42,000 for work done, and when it is remembered that the expenditure was not on manufacture, but merely on examining and testing, some measure of its service may be gained. Until last year the Royal Society was the governing body of the laboratory, and conducted its affairs with the assistance of a general board of thirty-six members, of whom twelve were nominees of industrial and commercial institutions. It was an almost ideal combination of science and industry, and Sir Richard Glazebrook gained the respect and admiration of his theoretical and practical masters. But the financial responsibility was heavy and increasing, and from April 1, 1918, the Department of Scientific and Industrial Research took over the burden. Fortunately under the new arrangement the department assumes only the control necessary for an accounting authority. Sir Richard will hand over to his distinguished successor, Professor Petavel, not only an institution of great and growing usefulness, but a tradition of harmonious cooperation between science and industry. He has provided the new Department of Scientific and Industrial Research with a working organization sufficient to justify their existence, and with a model on which we may suppose that their most successful creations, the Industrial Research Councils, have been formed.

THE DYE INDUSTRIES

During the course of its sessions at Philadelphia the Dye Section of the American Chemical Society, unanimously passed the following resolutions:

Whereas, The manufacture of dyes from coal tar distillates involves the same general processes and materials used in the manufacture of explosive and poison gases for military use,

Resolved, That the question of the importation of dyes and of intermediates from which they may be made is a military question,

Resolved, That the importation of such dyes, the bases from which dyes are made or the intermediate products produced in the manufacture of such dyes is a menace to the possible future defense of our country, for the reason that such importations foster and support in foreign countries which would furnish an enemy with essential munitions of war,

Resolved, That insofar as dyes or intermediates or coal tar distillates are allowed to be imported in time of peace, such importations prevent or discourage the establishment, development and maintenance of an industry that is essential to national defense in time of war,

Resolved, That a copy of these resolutions be submitted at once to the advisory committee of the American Chemical Society for such action as in its judgment the circumstances merit, with the suggestion that copies be sent to the President of the United States and the chairman of appropriate committees of the Congress.

Whereas, The American armies were factors in the victorious completion of the Great War *vs.* Germany, and

Whereas, The allied governments are placing corps of skilled chemists to oversee operations in the dyestuff plants in the occupied areas of Germany, and

Whereas, The American dyestuff industry is very much in need of any information that can be obtained to assist the development of this industry,

Now, therefore, be it resolved, That it should be brought to the attention of the President of the United States and an urgent request made that we have our share in the operating control of these factories and that we should have qualified representatives stationed there, the information gained to be used for the benefit of American industry.

Be it further resolved, That this tentative resolution be submitted at once to the Committee on National Policy of the American Chemical Society for such action as they think the circumstances merit.

Whereas, We find at the head of the laundry list of the Bellevue-Stratford Hotel the following notice: "Owing to dyes now being used, we will not assume any responsibility in the laundering of guests' apparel," and

Whereas, We find the similar lack of confidence in American dyes expressed by the department stores,

Now, therefore, be it resolved, That the Dye Section views with great disapproval the expression of any such misleading statements as to the quality of the American dyes,

Resolved, That this tentative resolution be submitted at once to the Committee on National Pol-

icy of the American Chemical Society for final but prompt action.

A COOPERATIVE COURSE IN ELECTRIC ENGINEERING

A COOPERATIVE course in electrical engineering, in which the General Electric Company combines with the institute has been established at the Massachusetts Institute of Technology. Students undertaking this work will have before them a course of five years in length. The first two are identical with the regular course in electrical engineering, and the last three will be divided between instruction in theory at the institute and instruction in practise at the West Lynn works of the General Electric Company. The regular four-year course will have certain omissions and abridgements, to make time for the work at Lynn, while the fifth year will be virtually postgraduate study with emphasis on problems of administration, project, design and research. The institute instructing staff has been strengthened by the addition to its electrical faculty of Professor Timble, who will be alternately at the institute and at the works with the students.

For the present class there will be eleven terms ahead, four terms a year. The first ten terms are to be spent in alternate study at the institute and at the works. The institute terms are of eleven weeks each, followed by two weeks' vacation, while the terms at the works in Lynn are of thirteen weeks each. One group of students will begin at the institute and the other at Lynn, and at the end of the term they will change places. The eleventh term, which is that just preceding commencement, will be spent by both groups at the institute. This, which is outside of the two preliminary years, will fill the time, and at the conclusion of the whole there will be an optional additional term of thirteen weeks at Lynn.

The successful completion of the course will lead to a degree of master of science, to be conferred at the graduation exercises of Technology, and the degree of bachelor of science will be conferred at the same time as of the preceding year.

This undertaking, which affords to the students the practise of the most important and largest kind of commercial work, is undertaken by the General Electric in order that it may have a supply of properly trained young men for its managers and superintendents.

THE CORNELL UNIVERSITY MEDICAL COLLEGE

THE Cornell University Medical College opened its twenty-second annual session on September 29, 1919. The annual address to the students was delivered by Dr. Graham Luck, professor of physiology. Two hundred and eighteen students are registered in the course leading to the degree of M.D., of whom 72 are registered for the first year in medicine in the New York City division of the medical college. There are in addition, forty medical students in the first year of medicine at Cornell University, Ithaca, N. Y., who will enter the New York City division for the second year, in 1921.

The college also announces the following appointments to the medical faculty in New York City.

E. F. DuBois, M.D., assistant professor of medicine, director of medicine, Bellevue Hospital.

Oscar M. Schloss, M.D., professor of clinical medicine, department of pediatrics.

Henry H. M. Lyle, M.D., assistant professor of surgery.

Jeremiah S. Ferguson, M.D., assistant professor of clinical medicine, department of pediatrics.

Nellis B. Foster, M.D., assistant professor of medicine and associate attending physician to New York Hospital.

John C. A. Cerster, M.D., assistant professor of clinical surgery.

Charles V. Morrill, A.M., Ph.D., assistant professor of anatomy.

Robert Chambers, A.M., Ph.D., assistant professor of anatomy.

THE LANE MEDICAL LECTURES

THE Lane Medical Lectures will be delivered this year by Dr. Alonzo E. Taylor, professor of physiological chemistry at the University of Pennsylvania. Dr. Taylor will speak on the "Feeding of the Nations at War." The lectures will take place at Lane Hall on Sacramento Street near Webster,

San Francisco, at 8 o-clock on the evenings of December 8, 9, 10, 11 and 12.

Dr. Alonzo Taylor was sent abroad under the auspices of the American Minister to make a scientific study of the care of the Allied prisoners in Germany. His reports were published by the British government in 1916 and 1917. At that time he was particularly interested in the food problems associated with nutrition of a people at war. Upon our entrance into the war he was one of the first men taken in by Mr. Hoover in the organization of the Food Administration. His particular problem was to coordinate the efforts of the Department of Agriculture and those of the newly established Food Administration. He was a member of the Committee on Research and on Public Health of the Food Administration and also a member of the commission sent abroad by this country to study the alimentation problems of the Allied nations. Subsequently he was the representative of the Department of Agriculture upon the War Trade Board. He made two different trips to Europe studying conditions there and since the armistice has been the representative of the Food Administration and the American Relief Administration particularly in the Balkan countries.

Dr. Taylor has written a series of articles dealing with various aspects of the war, particularly for the *Saturday Evening Post*. He is the author of a book on "War Bread" and with Dr. Kellogg published a book on "The Food Problem."

DINNER IN HONOR OF PROFESSOR CHAMBERLIN

A DINNER in honor of Dr. Thomas Chrowder Chamberlin was given at the Chicago Beach Hotel, on September 27. The dinner was occasioned by the retiring to become professor emeritus of Professor Chamberlin from the headship of the department of geology in order that he might devote himself to the research in which he is interested. The date of the dinner was felicitous in that it was within a few days of Professor Chamberlin's seventy-seven birthday.

About fifty people, almost solely former students and intimate colleagues of the guest of honor, were present. Dr. G. F. Kay, of the University of Iowa, acted as toastmaster, and speeches were made by Dean Rollin D. Salisbury, of the University of Chicago, Dr. C. K. Leith, of the University of Wisconsin, and Dr. F. R. Moulton and President Judson, both of the University of Chicago. At the end of the dinner, the toastmaster handed to Dr. Chamberlin a great number of congratulatory telegrams from friends all over the world.

SCIENTIFIC NOTES AND NEWS

MR. GEORGE H. ASHLEY, of the U. S. Geological Survey, has been appointed state geologist of Pennsylvania.

DR. SAMUEL A. TUCKER, formerly professor of electrochemistry at Columbia University, who served as major in the Chemical Warfare Service, has been appointed chief chemist for the Chemical Foundation, Inc.

DR. CHARLES L. PARSONS has resigned from the Bureau of Mines in order to give more time to the work of the secretaryship of the American Chemical Society. He will also undertake a limited amount of private consulting work.

DR. ARTHUR F. BUDINGTON, of Brown University, and Dr. Ralph W. G. Wyckoff, of Cornell University, have become members of the staff of the Geophysical Laboratory of the Carnegie Institution.

DR. ALBERT MANN, of Washington, D. C., has recently left the Department of Agriculture to accept a position with the Carnegie Institution of Washington. A recognition of the growing economic importance of the diatoms led the National Research Council to advise that plans be made to finance a thorough study of these aquatic plants. The Carnegie Institution received the suggestion favorably and Dr. Mann was invited to take up the work. His laboratory and office are located in the National Museum.

DR. CHRISTIAN R. HOLMES, dean of the medical college of the University of Cincinnati, has announced his intention of retiring from

practise to devote his entire time to the work of the college.

DR. L. H. BAEKELAND, honorary professor of chemical engineering in Columbia University, has been decorated by King Albert with the Order of the Crown of Belgium.

AT the centennial celebration of Colgate University on October 11, James M. Taylor, professor of mathematics in the university since 1870, received the honorary degree of doctor of science.

DR. GEORGE EMERSON BREWER, formerly professor of surgery in Columbia University, has sailed for France, at the request of the Surgeon General, as a representative of the United States at the inter-allied congress of surgeons shortly to convene in Paris. For the next five weeks Dr. Brewer temporarily resumes his rank as colonel in the medical division of the army, but by the middle of November he will return to civilian status in New York.

DR. KIRTLEY F. MATHER, professor of geology at Denison University, will be on leave of absence for the current year to undertake geologic exploration for Richmond Levering & Co. His work at Denison will be carried on by Dr. James H. Hance, formerly of the International Revenue Bureau, Washington, D. C.

SIR OLIVER LODGE, the British physicist, plans to visit the United States in the early spring of next year.

THE National Research Council has appointed a committee on Pacific exploration to consider and organize cooperative research in the various fields in which investigation is under way in the Pacific area. The first meeting of this committee was held on September 10, at the University of California. In order that through combined effort of the institutions concerned the fullest measure of result may be secured, the committee is especially desirious of securing information as to investigations under way or projected in the Pacific area in fields of research ranging from physics to anthropology. The members of the Committee present at the California meeting were H. E. Gregory, George F. McEwen, W. E. Ritter and J. C. Merriam, chairman. Other members of the committee were unavoidably absent. A meeting of the full committee for the purpose of initiating the investigations planned for the coming year will take place on the Atlantic coast in December.

OF the seventeen members of the faculty of the school of engineering at the Pennsylvania State College, who entered military service, the following have returned to take up their work: Captain E. D. Walker, A. E. F., head of the department of civil engineering; Captain John J. Light, A. E. F., assistant professor of mechanical engineering; Captain M. E. Kressly, instructor in engineering drawing, and Lieutenant Charles B. Steel, R. W. Minshall, A. Edward Bryan, John C. Runk and R. B. Nesbitt.

PROFESSOR MARK ALFRED CARLETON, who recently resigned from his position of cerealist with the U S. Department of Agriculture, is now making special field investigations for the U. S. Grain Corporation, with headquarters at 42 Broadway, New York City. While connected with the Department of Agriculture, Professor Carleton accomplished much in the way of introducing and establishing new and important varieties of cereal grains which have very materially increased the grain production in the United States. Of these might be mentioned Durum wheat, the production of which now amounts to approximately fifty million of bushels annually, and also the Kharkov Hard Winter wheat, the Swedish Select and Sixty Day oats, and the Petkus and Abruzzes rye. These various cereal grains, mainly the results of Professor Carleton's exploration and survey of Russia and Central Europe, are now standard crops in this country. Of his more purely scientific results, might been mentioned: The discovery of a sixth spore form of the rusts, the amphispore: the demonstration of winter hardiness of the uredo stage of leaf rust of wheat, and the discovery of distinct physiological forms of rust—the latter being made simultaneously with Eriksson.

DR. CYRIL HOPKINS, head of the department of agronomy of the University of Illinois,

died of malaria, at Gibraltar, on October 6. Dr. Hopkins was known as an international authority on soils. He had closed a year's work in reclamation studies of the worn soils of Greece and was on his way home when illness compelled his removal from the steamer.

The British prime minister has written to Lord Ernle (Mr. R. E. Prothero) a letter on his resignation of the presidency of the Board of Agriculture. Mr. Lloyd George says: "On behalf of the government I wish to thank you for the invaluable services you rendered the country during your remarkable tenure of office. Your chieftainship at the board marked an epoch in the history of British agriculture. It was the beginning of a departure which will soon, not only restore British land cultivation to its past prosperity, but lead it on to even greater heights of achievement. I feel a great pride in the fact that your work was done entirely during my premiership."

Preparations are being made for a conference of physiologists at Paris in July, 1920. The meeting is being organized by representatives from Great Britain, France and America, and invitations are to be sent to the neutral nations.

A bill has recently been passed by the Canadian House of Commons creating a Federal Department of Health. The bill provides for a minister of health, and an advisory council. The authority of the new department will extend to all matters affecting health within the jurisdiction of the Canadian government.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Richard M. Colgate, Colgate University receives a bequest of $100,000 to be used for the erection of a dormitory. Mr. Colgate also left $100,000 to Yale for the establishment of a professorship "for the advancement of the intellectual teaching of freshmen students."

The Bureau of Education has published a circular showing the increase of salaries of college teachers made during the last academic year and voted for the present year. Increases of ten per cent., or over for the last year are reported by 72 per cent. of the institutions for full professors, 51 per cent. for assistant professors and 52 per cent. for instructors. Of the institutions which reported an increase of over ten per cent. for the year 1920, 74 per cent. reported increases for full professors, 59 per cent. for assistant professors and 46 per cent. for instructors. It is noticeable that many larger institutions do not appear on the list of those which provided increases in salary in either year.

Dr. Daniel Russell Hadgdon, head of the Newark College of Technology, Newark, N. J., has been elected president of the Hahnemann College and Medical School, of Chicago. He is the author of works on "General Science," and "Applied Physics."

E. V. Huntington, associate professor of mathematics in Harvard University, has been promoted to a full professorship in mechanics. His teaching activities will be divided as heretofore between the division of mathematics and the division of engineering.

Paul B. Sears has accepted an assistant professorship of botany in the University of Nebraska and has begun his work there. He was formerly an instructor in the Ohio State University and during the war was a lieutenant in aviation. Previously he had been assistant in botany in the University of Nebraska.

Dr. A. R. C. Haas has been appointed associate professor of plant physiology in the University of California, Graduate School of Tropical Agriculture and at the Citrus Experiment Station at Riverside. He is engaged chiefly with studies in plant nutrition.

Dr. B. W. Wells, formerly of the University of Arkansas, has taken charge of the department of botany in the North Carolina State College. Mr. I. V. Shunk, of the University of West Virginia, has been appointed instructor in the same department.

Professor Newland F. Smith, of Centre College, Danville, Ky., has accepted a position as head of the department of physics in The Citadel, the Military College of South Carolina, at Charleston. He will commence his

work here as soon as his successor at Centre College is secured.

DR. H. L. IBSEN has been appointed assistant professor of animal husbandry, at the University of Wisconsin.

DR. FRANK C. GATES, formerly professor of biology at Carthage College, is now assistant professor of botany in charge of the herbarium at the Kansas State Agricultural College, at Manhattan Kansas.

MR. C. E. ALLRED has been appointed chief of the new Department of Agricultural Economics in the University of Tennessee. This department is to embrace all work done in farm economics, farm management and rural sociology. Research work in these subjects is being planned. Previous to taking up this work Mr. Allred was farm management specialist for Tennessee.

DR. WILLIAM F. PROUTY, assistant state geologist of Alabama since 1906, and professor of geology and mineralogy at the University of Alabama since 1912, has resigned to accept the professorship of stratigraphic geology at the University of North Carolina.

DR. DOUGLAS R. SEMMES, formerly professor of geology in the Agricultural and Mechanical College of Texas, and recently engaged in oil work in the Texas fields, has been elected associate professor of geology in the University of Alabama to fill the vacancy caused by the resignation of Dr. Prouty.

DISCUSSION AND CORRESPONDENCE

SNOW-ROLLERS

TO THE EDITOR OF SCIENCE: The wind-blown snowballs described by Mr. L. E. Woodman in your issue of August 30, p. 210–211, are known to meteorologists as "snow-rollers," and are rather frequently reported. The most extensive account of snow-rollers in the English language is that given in the *Quarterly Journal* of the Royal Meteorological Society, Vol. 34, 1908, p. 87–96. This is mainly a compilation of accounts of the phenomenon previously published in scientific books and journals, and is illustrated. Some of these accounts appeared in the Monthly Weather Review (published by the U. S. Weather Bureau). Probably the most important contribution to the subject of snow-rollers is the article "Schneewalzen," by Rudolf Meyer, in Korrespondenzblatt des Naturforscher-Vereins zu Riga, Vol. 52, 1909. This gives a list and analysis of all cases known to the writer between the years 1808 and 1909, and is accompanied by a bibliography which lists 35 previous papers on the subject in several languages.

C. F. TALMAN

U. S. WEATHER BUREAU,
WASHINGTON, D. C.

TO THE EDITOR OF SCIENCE: I was much interested in Professor Woodman's account of "A Snow Effect," in your issue of August 29. Years ago, at the time of the great blizzard in 1888, I saw the snow rolled up by the wind into pillow-like balls in Clay County, Kansas, and these snowballs were actually rolled uphill. The wind was very strong from the northwest and the snowballs were formed on slopes facing the northwest. The following note is taken from my diary of the time:

> January 12, 1888.—In the morning we had wind and snow from the southeast, which gradually changed to the southwest. The snow was very soft and moist and about six inches deep. At three o'clock P.M. the wind changed to the northwest, blowing very strong and cold, which rolled the snow up into large rolls like pillows, some being two feet in diameter and three feet long, and some even larger. In some places more than a dozen could be counted on a square acre.

These pillow-like balls were narrow in the center and became wider toward the outside, leaving a sort of funnel-like depression at each end.

JOHN H. SCHAFFNER

DEPARTMENT OF BOTANY,
OHIO STATE UNIVERSITY

TO THE EDITOR OF SCIENCE: A snow effect similar to that reported by Professor Woodman in your issue of August 29 occurred last spring at Fort Snelling, Minnesota.

The parade ground at the Fort was dotted one morning by snow balls. I thought, on

first seeing them, that the men had been discharging their excess energy by playing in the snow, and that the balls merely marked the beginning of a snow fort.

As I approached the parade ground, however, I noted, first, the absence of footprints in the snow; second, that the paths of the balls were in general parallel, and third, that the "balls" were rolled in one direction only, like cotton batting or a bundle of rugs, and that they were properly speaking "rolls" instead of "balls" So I was forced to the conclusion that they were the effect of the wind.

On questioning the old inhabitants of the Fort I learned that they were indeed wind-blown, and that such effects occurred not infrequently there.

The "balls" or "rolls" varied greatly in size. Some were over three feet in diameter, but the majority were smaller, about two feet. The largest one that I saw was about four feet in diameter and two feet thick.

They were all bi-concave. The paths in their wakes were triangular in shape, and varied greatly in length, depending of course on the size of the ball. The path of the large roll mentioned above was over fifty feet in length.

All the larger balls had fallen on one side, showing that size was not so much a matter of wind-power as it was of balance.

There were about three inches of soft snow on the ground, and the velocity of the wind was nearly cyclonic.

Karl M. Dallenbach
Cornell University

A WALL-SIDE MIRAGE

To the Editor of Science: Dr. Knowlton's note on "An unusual mirage" in Science for October 3, suggests mention of a mirage on a vertical north-south wall, on Garden Street, Cambridge, when the warm afternoon sun shines on it in quiet weather. If the observer stands close to the plane of the wall, he can easily see a mirror-like reflection of the elbow or of the side profile of a person who is walking near the wall, fifty or a hundred feet away.

W. M. Davis

QUOTATIONS

THE BRITISH ASSOCIATION

The authorities of the British Association for the Advancement of Science have made known their satisfaction with the meeting at Bournemouth, which ended last Saturday. This judgment doubtless was determined by the old standard, which, even before the war, was neither high nor rising. A warm welcome from the beautiful town, convenient arrangements for the meetings, summer weather, and nearly 1,500 members, including quite a number of scientific men, plenty of attractive subjects dealt with by speakers who "drew," and excursions with a decent scientific pretext—such were the materials that produced success. It is to be noticed that they would have suited the requirements of almost any kind of congress. It is more difficult to distinguish in them the "differentia" of a meeting for the advancement of science. Where revelations of the secrets of the war had been promised, there the visitors thronged. The vast growth of naval engines and armaments, hydrophones in fish-like cases, paravanes, sound ranging devices, airships and aeroplanes, tanks and submarine mines, poison gas and high explosives, excited and delighted the members of the British Association precisely as they would have excited and delighted the general public. There was a refrain of the achievements of British men of science, as opposed to the vaunted science of Germany, but there was very little of detailed scientific statement or discussion of methods. Almost equally popular were the items in the Educational Section. Sir Robert Blair on continuation schools, Bishop Welldon on citizenship, General Baden-Powell on the Boy Scout movement, other speakers on the advantages of private schools or the benefits of a sound knowledge of English, received and deserved attention. In mentioning a few other examples of the subjects that attracted large audiences we throw no doubt on the value of knowledge on the political bearings of international rivers, the use of hypnotism in treating shell-shock, or whether or not the working day should be

determined by legal enactment. But these, in fact, and as they were presented, have only a remote connection with science.

There is a double reason for the inconspicuous appearance of the scientific side at meetings of the British Association for the Advancement of Science. The results of research, if they are to be useful to other workers, or even if they are to increase the scientific reputation of their authors, must receive quick and effective publication. The organ of the British Association is a bulky annual volume, costly to buy, slow to appear, and cumbrous on private shelves. Prudent investigators prefer other means of making known their work, and hence offer to the association very little that is new. The traditional policy of successive councils, or more probably of the general officers who are the effective managers of the association, has been to cater for numbers rather than for quality. Hence the tendency in favor of the popular. Hence the continuous increases in the numbers of the sections and sub-sections, the wish to provide for any subject that can be alleged to have a connection with science. The theory no doubt is that these outer circles should be infiltrated with the scientific spirit. The practical result is that many papers are accepted by the British Association which are better suited, were they certain of acceptance, to specialized congresses, or to local debating societies. An excuse that is offered for this policy is that large attendances mean large receipts and the possibility of making large grants for more research. A sum of over £1,300, it is proudly stated, is to be provided for research by reason of the success of the Bournemouth meeting. Twelve sectional committees put in their claims on it, and a general committee, supposed to contain, and actually containing, some of the best brains in Great Britain, had to meet in solemn conclave to allot this vast sum.

The British Association does some good work. It could do much more. It serves as a meeting ground of men engaged in different branches of science. Were they not swamped by the camp-followers and separated by subdivision, they could really come together for the double purpose of social contact and of discussion of the technical methods on which the progress of science depends. It is the great annual opportunity for the publicity of scientific work. The more necessary that it should avoid the popular "copy" which has always a ready access to the lay organs of publication. The more vital that it should present the highest aims and needs of science. What is most vital is that it should insist on the advancement of science simply as knowledge, and not merely as a means to practical utilities. Certainly in the recesses of some of the sectional meetings, and in a few of the formal addresses, there was insistence on pure as opposed to applied research. But the small voice of the true scientific spirit was drowned by the resounding advertisement of the practical utilities that had come from science. Moreover, it frequently became shrill with personal protest—protest from scientific men who thought that they had been neglected or controlled by "practical" men. We do not dispute that the protests were sometimes just, and that it may have been useful to make them. But the nation, and perhaps even the government, which is a very different thing, will listen more readily to science at its best. And the best voice of science is neither protest, promise, nor boasting, but the proclamation of the intrinsic worth of knowledge spoken with faith and imagination.—The London *Times*.

SCIENTIFIC BOOKS

Un manuscrit inédit de Dolomieu sur la minéralogie du Dauphiné. Grenoble, imprimerie Allier Frères, 1919, 50 pp. 8vo.

We are indebted to Professor Alfred Lacroix, Secretaire Perpétuel of the Académie des Sciences, for the publication of an inedited manuscript of Déodat de Dolomieu. This treats of the mineralogy of the old province of Dauphiné, and embodies notes sent to Dolomieu by the city librarian of Grenoble, Du Cros. As a little of the nomenclature has become obsolete, Professor Lacroix has here and there supplied (in parentheses) the modern equivalents, and in a very brief

introductory note he gives a few details regarding the manuscript, which he believes was written in 1795 or 1796. One of the most interesting of Dolomieu's statements regards the gold deposits of La Gardette, an elevation in the southern part of Dauphiné.[1] Here gold was found in a quartz vein traversing a gneissic formation, at about 1,500 feet above the plain of Bourg d'Oisans, in the present department of Isère. As early as 1717 peasants are said to have picked up here yellow stones which when assayed in Grenoble were found to contain gold. In 1778 serious attempts were made to work this vein and a certain quantity of gold was extracted, a part of which was sent in the form of an ingot to the Comte de Provence, later Louis XVIII, who caused a medal to be struck out of this gold.[2]

G. F. K.

NOTES ON METEOROLOGY AND CLIMATOLOGY

THE TRANS-ATLANTIC FLIGHTS AND OCEAN WEATHER MAPS

Although some attempt has been made to post daily weather maps of the North Atlantic in the New York Customs House, the occasions of trans-Atlantic flights first brought forth daily weather maps of the North Atlantic from which oceanwide forecasts were made. In fact, for a short time in the middle of May such weather maps were being made every six hours from weather reports received by radio from European and American land stations and from the five American battleships and ten destroyers spread over the Atlantic between latitudes 36° and 51° N.

Unfavorable winds for the flight of the NC planes to the Azores lasted until May 16, when in the rear of a low pressure trough, fair weather and westerly winds prevailed from Newfoundland nearly to the Azores. Thinking (justifiably, as it proved) that such favorable conditions would not last long and would not continue again for some time, the forecasters advised that conditions were favorable for the start of the flight to the Azores. The second stage of the flight of the NC-4 to Lisbon was delayed till the twenty-seventh, when a following wind appreciably shortened this long flight. A detailed account of "The first trans-Atlantic flight," with 14 weather maps of the North Atlantic, May 12–20 and 27–31 and of the forecasts in this connection, by W. R. Gregg and E. H. Bowie have been published in the *Monthly Weather Review*, May, 1919, pp. 279–282, 347.

In addition to such weather information as the Americans gave the British aviators on this occasion, the British Meteorological Office was actively engaged in getting weather reports from merchant ships on the ocean along the route from Newfoundland to Ireland. As many have no radio outfits, and as only an occasional ship can send reports more than a few hundred miles, the conditions along this course have been but poorly known in time to be helpful. Stormy weather on either coast kept aviators from starting, but the lack of stormy conditions on either coast did not mean safety in mid-ocean. Messrs. Hawker and Grieve, after leaving Newfoundland, May 18, ran into the northern part of the storm which was so distressing to the crew of the NC-3. In spite of climbing to a considerable height they were unable to get above the clouds; and the strong north wind hindered their progress appreciably.[11]

Although Messrs. Alcock and Brown also experienced considerable cloudiness, the wind conditions, strong westerly all the way, appear to have been ideal for their flight from Newfoundland to Ireland, June 14–15. If they flew on a great circle course the average speed was about 120 miles an hour.[12]

By the time the R-34 was ready to make its trip to America, the receipt of weather reports by radio from vessels at sea was better, though there were great stretches from which no in-

[1] *Op. cit.*, pp. 16–20.

[2] In Professor Lacroix's great work "Minéralogie de la France et de ses Colonies," Vol., 1897, p. 422, this medal is figured.

[11] See *Monthly Weather Review*, May, 1919, p. 283.

[12] See account and weather maps in the *Monthly Weather Review*, June, 1919, p. 416, charts X. and XI.

formation was to be had. The weather forecasters, nevertheless, were able to pick favorable times for the trips both coming and going. The encounters with thunderstorms on the American coast, and the danger of ignition of the hydrogen by lightning have caused a call for thunderstorm statistics over the oceans. Fortunately, thunderstorms are much less numerous on coasts than inland. The danger to trans-oceanic dirigibles, however, is present the year round, and both night and day, for land thunderstorms, which may drift a short distance out to sea occur mostly by day in summer, and ocean thunderstorms occur mostly at night and in winter. Mr. W. R. Gregg, the Weather Bureau representative at Mineola during the stay of the R34, has prepared an account of the meteorological aspects of the voyage of the R34.[13]

I quote from his synopsis:

> The British dirigible R34 flew from the British Isles to the United States in 108 hours and made the return trip in 75 hours, a good illustration of the influence of the prevailing westerlies in trans-Atlantic flight. During the first day of the westward trip northeasterly and easterly winds furnished some assistance, but thereafter cross winds or head winds were encountered most of the time. On the return trip southwesterly and westerly winds added considerably to the air speed of the ship. Inasmuch as it was necessary to moor the ship in the open at Roosevelt Field [it was necessary to guard against] . . . the sea breeze, thunder-storms, and alternate heating and cooling of the gas through the interruption of insolation by passing clouds.

The British have now taken steps to inaugurate a radio collecting and issuing system for weather reports and forecasts for marine and aeronautical interests in all parts of the world.[14]

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[13] *Monthly Weather Review*, August, 1919; daily North Atlantic weather maps by F. A. Young in July issue.

[14] See *Symon's Meteorological Mag.*, May, 1919, pp. 37–38; noted in *Geog. Rev.*, June, 1919, p. 421, and reprinted in *Mo. Weather Rev.*, June, 1919, p. 417.

SPECIAL ARTICLES

NEW FRUIT FUNGI FOUND ON THE CHICAGO MARKET

THE present paper gives a description of the diseases as they were seen on the fruit rather than a study of the fungus itself.

The new fruit diseases found on the Chicago market are as follows: a new *Botrytis* on apple, *Polyscytalum* on grapefruit and *Fusarium* on grapefruit.

Botrytis sp. was first isolated from a northwestern Spitzenburg, and later found on northwestern Arkansas Black and Winesap. Five Spitzenburg apples affected with *Botrytis* were taken from the same box.

The affected Spitzenburgs were entirely rotted. The apples were very soft but the rot was firmer than that produced by *Penicillium*. The pigments of the skin had stained the underlying tissues to a depth of a quarter of an inch. The apples were covered with a very fine white growth of decumbent mycelium.

In 1918 *Botrytis* sp. was studied at the University of Illinois. The species of *Botrytis* was isolated from an apple covered with a thick, heavy growth of grayish mycelium. The fungus tufts arose a half an inch from the surface of the apple. Inoculations of conidiospores upon disease free fruit produced similar growths. The conidiospores averaged 6μ in diameter. The conidiospores of the *Botrytis* in the present paper averaged 4μ in diameter. As far as the writer has been able to learn, no *Botrytis* of this dscription has ever been recorded.

The perfect and the imperfect stage of *Botrytis* sp. develops in the same culture tube. The asci are arranged in a layer which constitutes a convex hymenium. The hymenium is formed on a very loose structure of mycelium. Paraphyses are present. There were no ascospores produced during the four months the fungus was under observation. The asci averaged 51μ x 11.5μ. Sclerotia are seen in culture with the naked eye at the end of two weeks.

Five series of inoculation tests were made using the Spitzenburg variety of apple. Ten apples were used each time. Care was taken

to have the apples in as sterile a condition as possible. The apples were washed thoroughly in tap water, allowed to remain in mercuric chloride (1: 1,000) for five minutes, washed in water that had been boiled, then rinsed in 95 per cent. alcohol. Two punctures were made on each apple with a sterile platinum needle. The inoculum of conidiospores was applied to each puncture with a sterile loop needle. The inoculated apples were placed in a sterile granite pan and covered over with a similar pan. The total diameter in millimeters of the spots on the ten apples was recorded. The five series of inoculations were averaged and the results recorded in the following table:

Apples inoculated on May 10: May 13, 140 mm.; May 15, 414 mm.; May 17, 788 mm.; May 19, 1,060 mm.; May 21, 1,386 mm.

POLYSCYTALUM ON GRAPEFRUIT

Polyscytalum has only been found on the market three times and as yet is not a disease of importance.

The fungus was isolated from a slightly sunken soft area one half an inch in diameter. The spot was of a little lighter color than the color of the fruit itself. The spot has the appearance of a blister filled with water. In the early stages of the disease the rot works down to the pulp of the fruit in a perpendicular manner. The affected tissue is very soft, more so than that attacked by *Penicillium*. When a spot has reached the diameter of 20 or 25 millimeters the fungus begins to attack the pulp of the fruit. An attacked fruit soon becomes a soft mushy mass.

Five series of inoculations were made using four grapefruits in each series. The average development of a spot is shown as follows: fruit inoculated May 10, May 17, 55 mm.; May 19, 49 mm.; May 21, 70 mm.; May 23, 91 mm.

GRAPEFRUIT FUSARIUM

Fusarium sp. was first found on a shipment of Florida grapefruit. The fungus was found enough on the Chicago market to classify it as a disease of economic importance.

The isolation was made from a tan to reddish brown rough sunken area an inch in diameter. The tissue underneath was dry, corky, and of a tan color extending inward an eighth of an inch. These rough sunken areas often reach the size of two and a half by one and a half inches. In the case of the larger spots the fungus often develops down into the pulp of the fruit causing a rot. A black and pink development is made in the host tissue. A very fine white cottony growth often develops in the pulp of the fruit and sometimes on the surface of the brown rough area.

Ten series of inoculations were made using three grapefruit in each inoculation. The average growth of a spot is shown as follows: fruit inoculated April 24, May 1, 5 mm. in diameter; May 19, 10 mm.; May 29, 17 mm.; June 2, 20 mm. It is seen that a *Fusarium* spot develops very slowly. However, in fifty per cent. of the inoculations when a spot had reached a diameter of twenty of twenty-five millimeters a rot developed at the edge of the sunken area. When *Fusarium* acts in this manner it is very serious, for a grapefruit will be a worthless rotten mass within forty-eight hours after the rot has started.

In order to discover what fruit diseases are of economic importance one has to study them from a market point of view as well as in the field. Some diseases are field infections which develop and spread under transit and storage conditions. A more complete study of fruit diseases as occuring on the market will reveal many diseases as yet unknown to plant pathologists.

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